

## UNDERSTANDING DIVERGENT EVOLUTION OF EARTH-LIKE PLANETS: THE CASE FOR A VENUS EXPLORATION PROGRAM

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The planet Venus is our most Earth-like neighbor in size, mass, and solar distance. In spite of these similarities, the Venus surface and atmosphere are characterized by some of the most enigmatic features seen anywhere in the solar system. Here, we propose a Venus exploration program designed to explain the origin and divergent evolution of the interiors, surfaces, and atmospheres of the terrestrial planets in our solar system, and provide greater insight into the conditions that may affect the habitability of terrestrial planets in other solar systems. This program includes:

- The Noble Gas and Trace Gas Explorer is the highest priority mission because its data are vital to our understanding of the origin of Venus. This Discovery class mission requires a single entry probe that will carry the state-of-the-art instruments needed to complete the noble gas and trace gas inventories between the cloud tops and the surface.
- The Global Geological Process Mapping Orbiter is a Discovery class mission. It will carry a C- and/or X-band radar designed for stereo or interferometric imaging, to provide global maps of the surface at horizontal resolutions of 25 to 50 meters to identify and characterize the geologic processes that have shaped the Venus surface.
- The Atmospheric Composition Orbiter is a Discovery class mission that will carry remote sensing instruments for characterizing clouds and trace gas variations throughout the atmosphere. This mission will collect the data needed to characterize the radiative, chemical, and dynamical processes that are maintaining the thermal structure and composition of the present atmosphere.
- The Atmospheric Dynamics Explorer is a New Frontiers class mission that will deploy 12 to 24 long-lived balloons over a range of latitudes and altitudes to identify the mechanisms responsible for maintaining the atmospheric superrotation.
- The Surface and Interior Explorer is a New Frontiers class mission that will deploy three or more long-lived landers on the Venus surface. Each lander will carry a seismometer for studies of the interior structure, as well as *in situ* instruments for characterizing the surface mineralogy and elemental composition. This mission requires significant technology development.
- A Sample Return mission will eventually be needed to conduct investigations of the Venus surface and atmosphere that cannot be conducted by instruments on remote sensing platforms or on entry probes. This will probably require a large mission and significant technology development.

This series of missions will complement and expand on the science objectives of the proposed ESA Venus Express Mission and the ISAS Venus Climate Orbiter.